

Research Article

Seroprevalence of *Leptospira* Species and Risk Factors in Livestock and Rodents in Kondoa Town Council Dodoma, Tanzania

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Abstract

Leptospirosis remains a globally re-emerging zoonotic disease, undermining livestock productivity and posing public health risks. A cross-sectional study was conducted to estimate the seroprevalence of *Leptospira* infection in domestic ruminants and rodents in Kondoa Town Council (TC) from October 2024 to January 2025. A total of 274 domestic ruminants (cattle, goats, and sheep) and 225 rodent blood samples were collected and assessed for *Leptospira* antibody using the Microscopic Agglutination Test (MAT). Data were analysed in Epi info 7.2.6.0 whereby descriptive statistics were used to estimate prevalence of factors and logistic regression to identify potential risk factors for seropositivity. Overall seroprevalence of *Leptospira* in domestic ruminants was 18.9%, and the majority were detected in cattle 24.5%. Five *Leptospira* serovars were detected in domestic ruminants, including *L. Pomona*, *L. Sokoine*, *L. Hebdomadis*, *L. Grippotyphosa* and *L. Canicola*. In rodents, the seroprevalence was 5.8%, and four *Leptospira* serovars were detected, including *L. Pomona*, *L. Sokoine*, *L. Hebdomads* and *L. Lora*, which was more prevalent. Geographic location and history of abortion were significant factors for *Leptospira* infection in domestic ruminants ($p < 0.002$). The findings underscore the importance of integrated rodent and environmental management strategies to control *Leptospira* infection, particularly in endemic regions. This study contributes to the understanding of *Leptospira* epidemiology in Tanzania and emphasizes the need for surveillance and community education to mitigate zoonotic diseases transmission.

Keywords

Leptospirosis, *Leptospira* spp, Serovars, Domestic Ruminant, Rodent, Kondoa TC

1. Introduction

Leptospirosis is a neglected zoonotic disease affecting humans and animals in tropical and subtropical countries [1]. The disease is caused by pathogenic spirochetes of the genus *Leptospira*. More than 250 pathogenic *Leptospira* serovars have been identified to cause *Leptospira* infection worldwide

[2]. Some of the reported pathogenic serovars are endemic, meaning that they are confirmed in the location where they are known to affect specific animals [3]. Transmission of *Leptospira* infection can occur through direct contact with infected animal urine or indirectly through contaminated soil, water,

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sexual transmission within species, and vertical transmission from mother to foetus or neonate through transplacental and transmammary transmission [4]. In humans, signs and symptoms range from mild, flu-like illness to severe conditions, fever, jaundice, chill, muscle pain, renal failure and pulmonary hemorrhage [5, 6]. In animals, *Leptospira* infection is reported to cause stillbirth, abortion, decreased milk production, and high mortality rates. The disease is of public health and economic importance since it causes unsafe food, great productivity losses, and increased medical expenses [7, 8].

Leptospirosis is distributed worldwide; it is more prevalent in tropical countries with factors like neutral or alkaline soils, global warming, extreme weather events, excessive rainfall, population growth, and urbanization. In Africa, and particularly in East Africa, the disease has attracted increasing attention due to the frequent interaction between humans, domestic animals, and rodents, which are major reservoirs of the pathogen. High rainfall, flooding, poor waste management, and occupational exposure among farmers and livestock keepers increase the risk of infection [6].

The global incidence of human leptospirosis is 1.03 million cases and 58,900 deaths [5, 7, 9]. In Tanzania, the epidemiology of leptospirosis dates back to the early 1990s, highlighting the presence of the disease in humans, domestic animals, and wildlife. The estimated incidence among humans ranges from 75-102 cases per 100 000 persons annually in 2007-2008 and from 11-18 cases per 100 000 persons annu-

ally in 2012-2014 [3, 10]. Several studies have confirmed the widespread nature of the disease across various regions and host species, with seroprevalence in humans of 0.3% to 29.9%; cattle, 5.6% to 51%; goats and sheep, 62%, dogs 9.5 to 38%, rodents and shrews 1.8% to 25.8%; and buffaloes 29% [3, 6]. Further, in 2022, an outbreak of leptospirosis occurred in Kilwa District, Lindi region, that resulted in 20 confirmed human cases and three deaths [10]. This occurred after the residents had increased interactions with rodents in the contaminated environment including consumption of raw or undercooked rodent meat.

Findings from previous studies have shown that in Tanzania leptospirosis is common in humans, livestock, and wild mammals, and the magnitude varies depending on the locality and hosts [3, 6]. However, information regarding the *Leptospira* infection in humans and animals is still limited in some areas, including Kondoa TC, habituated residents mainly engaged in agriculture, livestock production, fishing, and some natural resource conservation, in particular Swagaswaga Game Reserve and some forest reserves. The purpose of this study was to establish the magnitude of *Leptospira* and explore the possible risk factors for infection in domestic ruminants and rodents in Kondoa TC, Dodoma, Tanzania. The study provides valuable data on the extent of exposure to domestic ruminants and rodents, which are constantly in contact with humans. This baseline information is expected to guide the policymakers on the prevention and control of *Leptospira* infection in humans and animals.

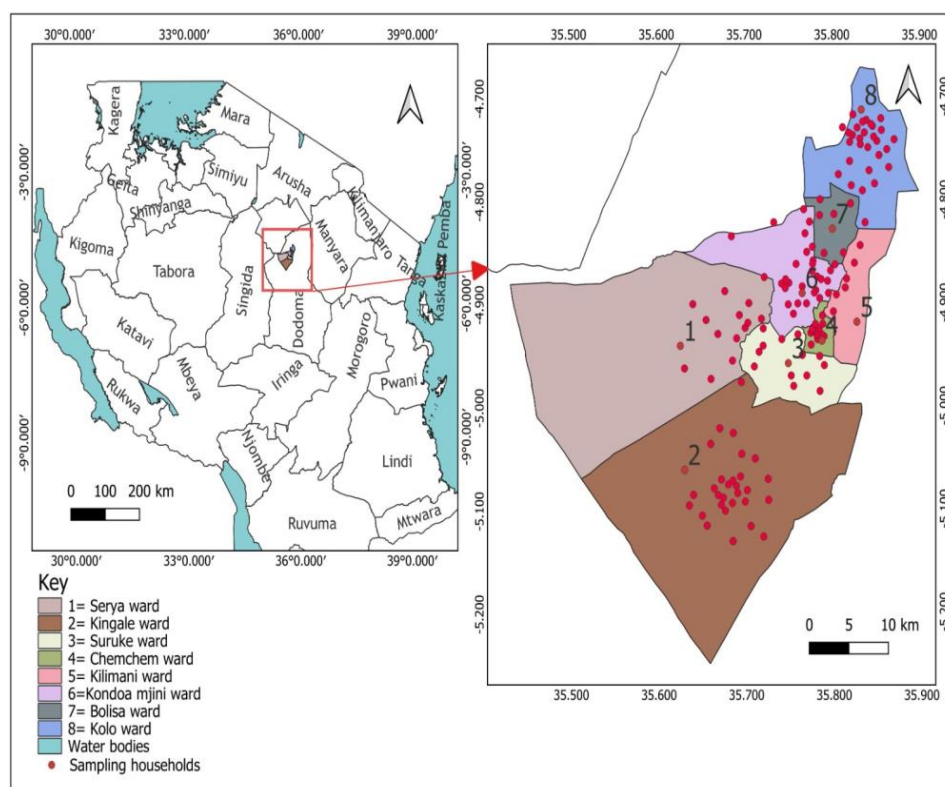


Figure 1. A map of Tanzania showing the relative position of Dodoma region where Kondoa TC is located. Note that the insert is a map of Kondoa TC that shows the study wards numbered 1-8 and the red dots are 16 study streets.

2. Materials and Methods

2.1. Study Area

This study was conducted in Kondoa Town Council, located in central Tanzania, at latitudes: 4°12' to 5°38' South and longitudes 35°6' to 36°2' East. The climatic condition is a semi-arid area with an average rainfall of between 500 and 1000 mm. For about 85% of the annual rainfall occurs between December and March, with a dry spell noted in February. The temperature ranges between 16 °C and 26 °C, and the relative humidity is 67%. Kondoa TC comprises 8 wards and 36 streets. The council consists of 80,443 human population with an annual population growth rate of 3.9 and 20,396 households. The study area has approximately 30,503 cattle, 18 491 goats, and 3,356 sheep. The main economic activities are crop production and livestock keeping. A large portion of the area, approximately 76%, is covered by forest, which involves the wildlife areas of Tarangire National Park and Swagaswaga Game Reserve. The increased interaction between humans, animals and rodents, which may increase the risk of *Leptospira* infection, was the main reason for selecting the current study area. This study included eight wards namely Kondoa Mjini, Chemchem, Bolisa, Kilimani, Suruke, Kingale, Serya, and Kolo (Figure 1).

2.2. Study Animals and Population

The study animals included domestic ruminants, which are indigenous breeds managed under an extensive grazing system. On rare occasions, some farmers keep crossbreeds of dairy cattle. The common diseases control includes routine dipping of animals in acaricides and vaccination against some diseases like Contagious Bovine Pleuropneumonia (CBPP), anthrax, and black quarter. In households that keep dogs, there are also routine vaccinations against rabies. Prophylactic uses of anthelmintics and Isometamidium chloride are also practiced to control helminths and trypanosomiasis respectively.

2.3. Study Design

A cross-sectional study was conducted across all eight wards of Kondoa Town Council from October 2024 to January 2025. From each ward, two streets were purposely selected based on the presence of a large number of households involved in livestock and crop production and those experiencing significant rodents - related challenge.

2.4. Sample Size Estimation

The sample size estimation was determined by using the following equation developed by formula: $n = Z^2 p (1-p) / d^2$. (Cochran 1963; Israel 1992). Note that n = sample size, P = Known or estimated prevalence, d = desired precision 5%,

Z = z-score corresponding to the level of confidence (1.96 for 95% confidence). The known prevalence of leptospirosis in rodents, cattle, sheep and goats were 17%, 5.6%, 1.2% and 8.47% respectively (Mgode *et al.*, 2021; Assenga *et al.*, 2015; Motto, *et al.*, 2021). Based on these, the collected sample size for rodents, cattle, goats and sheep were 225,106, 137 and 31 respectively.

2.5. Sampling and Sample Handling

2.5.1. Rodent Trapping, Blood Sample Collection and Identification

Rodent trapping sites were strategically selected, including crop production, human settlement, crop stores, poultry houses, bushes, dumping areas, and livestock kraals. Trapping of rodents was done between November and December of 2024. Sherman traps (8×9×23 cm) baited with peanut butter mixed with maize flour were used in rodent trapping. For the outdoors, the traps were spaced 5 meters apart. Traps were set in the evening and inspected early in the morning. Captured rodents were collected and transported to the Kondoa TC livestock office for blood collection and identification.

The captured rodents were euthanized in a container with cotton wool soaked with diethyl ether, thereafter, one to two millilitres of whole blood were drawn by cardiac puncture or supra-orbital vein and then placed in Eppendorf tubes. The blood was allowed to settle before centrifugation at 4000 rpm for 10 minutes. The sera were transferred into microvials and stored at -20 °C before being transported to the Sokoine University of Agriculture, Institute of Pest Management (IPM) laboratories for analysis. The euthanized rodents were identified to the genus or species level based on morphological features (weight, body length, tail length, hind foot length, and ear length), sex, and age as stated by [30].

2.5.2. Selection Criteria for Study Households and Livestock, and Questionnaire Administration

Households for participation in the study were selected based on the criteria of: livestock keeping and crop production, accessibility, and willingness to participate in the study. Two streets were randomly chosen, and from each ward, a minimum of 12 households that had met the selection criteria were randomly selected for blood sample collection from livestock. The heads of selected households were administered a semi-structured questionnaire that had been developed, pretested, and translated into Kiswahili, a common language spoken in Tanzania. The information collected included demographic characteristics of the respondents, livestock bio-data, management practices, challenges of livestock diseases, and incidences of abortion. Livestock were considered young at the age of four months to one year and adults above one year. For simplicity, livestock herd size was categorized as small when it had 1–50 animals, medium with 51–100, and

large with over 100 animals.

2.5.3. Livestock Blood Sampling and Serum Preparation

The selected cattle, goats, and sheep were manually restrained, and 5-10 ml of blood samples were collected using a plain vacutainer tube from the jugular vein. The collected blood was allowed to clot and was centrifuged at 4000 rpm for 10 minutes, and the sera were transferred into cryovials and stored at -20 °C before being transported to Sokoine University laboratory for analysis.

2.5.4. Microscopic Agglutination Test (MAT)

Microscopic Agglutination Test was conducted to detect antibodies against *Leptospira* in serum samples. Six serovars reported in Tanzania, namely *L. Canicola*, *L. Pomona*, *L. Grippotyphosa*, *L. Sokoine*, *L. Hebdomadis* and *L. Lora* were used in this study. Live *Leptospira* were used as antigens after was grown in Ellinghausen and McCullough medium modified by Johnson and Harris (EMJH) (Difco-USA) media [13]. The antigen cultures were incubated at 30 °C for not more than seven days. The clarity was observed using a dark field microscope until they attained the recommended density of 300×10^8 leptospires /ml. Briefly, 10 µl of sera were mixed with 90 µl phosphate-buffered saline (PBS) to create a 100 µl diluted serum in a U- shaped microtiter plate. Serial dilution was done by taking 50 µl of serum-PBS mixture from a tested row of each microtiter plate to the next rows containing 50 µl PBS consecutively at 1:10, 1:20, 1:40, 1:80, and 1: 160. Then 50 µl of live leptospire antigen was placed in all wells of microtiter plates, and the dilution was doubled from 1:10 to 1:20, 1:20 to 1:40, 1:40 to 1:80, 1:80 to 1:160 in the microtiter plates. In each plate, the first upper row served as negative control; the test was done in the second rows of each microtiter plate [1, 6]. The microtiter plate was incubated for two hours and thereafter observed under darkfield microscopy for the evidence of agglutination. Positive samples at titers above 1:20 were further diluted and retested to establish the cut-off agglutination

titters defined as the dilution at which 50% of the leptospires agglutinated, compared to the negative control containing PBS and live cultures. A sample was considered positive in titres 1:20 to 1:160 in rodents and domestic ruminants [1, 6].

2.7. Data Analysis

The collected data were verified, cleaned, and entered into Microsoft Excel worksheets. Descriptive statistics, including percentages, frequencies, medians, and means, were used to describe and summarize data. Data analysis was conducted using Epi Info 7.2.6.0. The chi -square test was applied to assess associations between the biodata of the domestic ruminants, area of origin, history of abortion, and grazing/feeding system against the outcome variable being *Leptospira* positives. Logistic regression analysis was performed to determine the odds of the tested factors for *Leptospira* infection and assess their significance. All statistical analyses were carried out at a significant level of 0.05, with 95% confidence intervals.

3. Results

3.1. General Information and Seroprevalence of *Leptospira* Infection in Rodents

A total of 225 rodents were trapped from the study wards, as shown in Table 1. Of these, 115 rodents (51.1%) were trapped in Kondoa Mjini, and the majority (55.1%; n=124) were *Avicantis* species, whereas *Aethomys* species was the least trapped (0.4%, n=1). Most rodents trapped were adults (53.3%, n=120) and mostly from crop farms (68%, n= 153). The 225 sera samples from rodents indicated that 5.8% (n=13) were positive for *Leptospira* antibodies. Comparison of possible factors for infection indicated that the rodent's species was statistically significant implying that infections varied among species.

Table 1. Information and seroprevalence of *Leptospira* infection in trapped rodents in Kondoa TC (n=225).

Parameters	Categories	No. (%) of rodents	No. (%) of positive rodents	P value
Wards	Chemchem	93 (41.3)	6 (6.5)	0.9304
	Kondoa mjini	115 (51.1)	6 (5.2)	
	Kilimani	17 (7.6)	1 (5.9)	
	<i>Avicantis spp</i>	124 (55.1)	5 (4.0)	
	<i>Rattus rattus</i>	68 (30.2)	3 (4.4)	
Rodents species	<i>Mastomys natalensis</i>	30 (13.3)	4 (13.3)	0.0232*
	<i>Aethomys spp</i>	1 (0.4)	0 (0.0)	
	<i>Tatera spp</i>	2 (0.9)	1 (50.0)	

Parameters	Categories	No. (%) of rodents	No. (%) of positive rodents	P value
Sex	Male	114 (50.7)	7 (6.1)	0.8133
	Female	111 (49.3)	6 (5.4)	
Age groups	Adult	120 (53.3)	7 (5.8)	0.9695
	Juvenile	105 (46.7)	6 (5.7)	
Trapping habitats	Crop farms	153 (68.0)	9 (5.9)	0.192
	Human houses	32 (14.2)	2 (6.3)	
	Poultry houses	22 (9.8)	0 (0.0)	
	Livestock kraal	9 (4.0)	0 (0.0)	
	Dumpo sites	6 (2.7)	1 (16.7)	
	Bush	3 (1.3)	1 (33.3)	
	Total	225 (100)	13 (5.8)	

* Statistically significant $P < 0.05$ at 95% confidence interval

3.2. Detection and Distribution of *Leptospira* Serovars in Rodent Species

The results showed that four serovars tested positive against rodents' species. Most samples tested positive at 1:40 titre dilution, and *L. Lora* was most prevalent among the

tested serovars. Two co-infections were observed in *Avicanthis* spp. All rodent species, with the exception of *Aethomy* spp reacted positive with at least one of the tested serovars; *Avicanthis* spp, was more prevalent compared to other tested species of rodent, while *Tatera* spp reacted with only one serovars.

Table 2. The number rodent samples which tested positive in different titres.

Serovar	Titres	<i>Aethomys</i> spp. (n=1)	<i>Avicanthis</i> spp. (n=124) *	<i>Mastomys natalensis</i> (n=30)	<i>Rattus rattus</i> (n=68)	<i>Tatera</i> spp. (n=2)	Total (N=225)
L. Pomona	1:20	-	-	1	-	-	1
	1:40	-	2	1	-	-	3
	1:80	-	-	-	-	-	-
	1:160	-	-	-	-	-	-
L. Sokoine	1:20	-	-	-	-	-	-
	1:40	-	-	1	2	-	3
	1:80	-	-	-	-	-	-
	1:160	-	-	-	-	-	-
L. Hebdomadis	1:20	-	-	-	-	-	-
	1:40	-	2	-	1	-	3
	1:80	-	-	-	-	-	-
	1:160	-	-	-	-	-	-
L. Lora	1:20	-	2	1	-	1	4
	1:40	-	1	-	-	-	1
	1:80	-	-	-	-	-	-

Serovar	Titres	<i>Aethomys</i> spp. (n=1)	<i>Avicantis</i> spp. (n=124) *	<i>Mastomys na-</i> <i>talensis</i> (n=30)	<i>Rattus rattus</i> (n=68)	<i>Tatera</i> spp. (n=2)	Total (N=225)
	1:160	-	-	-	-	-	-
Total		-	7	4	3	1	15

*2-Co-infection

3.3. General Results on Domestic Ruminants

General results on domestic ruminants are shown in Table 3. A total of 274 domestic ruminants were sampled, comprising

106 cattle (38.7%), 137 goats (50%), and 31 sheep (11.3%). Most domestic ruminants were from Kingale ward (16.4%; n=45) which were mostly local breeds (95.9%, n=263), female (68.6%, n=188), and adult (95.9%, n=263) that were extensively grazed (86.1%, n=236).

Table 3. Biodata and grazing system of domestic ruminants in Kondoa TC (n=274).

Parameter	Category		Number of livestock	Percentage
Ward	Kingale		45	16.4
	Serya		43	15.7
	Chemchem		32	11.7
	Kilimani		32	11.7
	Suruke		32	11.7
	Bolisa		30	10.9
	Kolo		30	10.9
	Kondoa Mjini		30	10.9
Animal type	Cattle	Local	99	36.1
		Cross breed	7	2.6
	Goat	Local	133	48.5
		Cross breed	4	1.5
	Sheep	Local	31	11.3
		Cross breed	0	0.0
Age group	Cattle	Adult	95	34.7
		young	11	4.0
	Goat	Adult	137	50.0
		young	0	0.0
	Sheep	Adult	31	11.3
		young	0	0.0
	Cattle	Female	69	25.2
		Male	37	13.5
Sex	Goat	Female	97	35.4
		Male	40	14.6
	Sheep	Female	22	8.0
		Male	9	3.3

Parameter	Category		Number of livestock	Percentage
Grazing system	Cattle	Extensive	97	35.4
		Semi-intensive	9	3.3
	Goat	Extensive	108	39.4
		Semi-intensive	29	10.6
	Sheep	Extensive	31	11.3
		Semi-intensive	0	0.0
Herd size	Small		222	81.0
	Medium		41	14.9
	Large		11	4.0
History of abortion	No		247	90.1
	Yes		27	9.9
Total			274	100.00

3.4. Seroprevalence and Distribution of *Leptospira* Serovars in Domestic Ruminants

Table 4 presents the occurrence and distribution of *Leptospira* serovars in domestic ruminants. The overall seroprevalence was 18.9% (n=52), with cattle showing the highest

prevalence at 24.5% (n=26), followed by sheep at 19.4% (n=6), and goats at 14.6% (n=20). Five *Leptospira* serovars were identified: *L. pomona* (36.5%, n=19), *L. Sokoine* (25.0%, n=13), *L. Hebdomadis* (23.1%, n=12), *L. Grippotyphosa* (13.5%, n=7), and *L. Canicola* (1.9%, n=1). All animal types reacted with at least one the tested serovars.

Table 4. Seroprevalence and distribution of *Leptospira* serovars in domestic ruminants.

Serovar	Titre	Cattle	Goat	Sheep	Total
L. Canicola	1:20	-	1	-	1
	1:40	-	-	-	-
	1:80	-	-	-	-
	1:160	-	-	-	-
L. Pomona	1:20	4	2	-	6
	1:40	1	2	3	6
	1:80	1	2	-	3
	1:160	-	3	1	4
L. Grippotyphosa	1:20	1	1	-	2
	1:40	3	-	-	3
	1:80	2	-	-	2
	1:160	-	-	-	-
L. Sokoine	1:20	1	-	-	1
	1:40	3	4	1	8
	1:80	-	2	-	2

Serovar	Titre	Cattle	Goat	Sheep	Total
L. Hebdomadis	1:160	-	1	1	2
	1:160	1	-	-	1
	1:20	-	1	-	1
	1:40	5	-	-	5
	1:80	4	1	-	5
Total		26	20	6	52

3.5. The Distribution of Positive Samples Across Different Livestock Parameters

Table 5 shows the distribution of *Leptospira* antibody positivity among domestic ruminants based on eight parameters: ward of origin, animal species, breed, age, sex, herd size,

grazing system, and history of abortion. Statistical analysis revealed that animals with a history of abortion were significantly more likely to be seropositive for *Leptospira* antibodies ($P < 0.02$).

Table 5. The distribution of *Leptospira* antibody in domestic ruminants based on different parameters in Kondoa TC.

Parameter	Category	No. (%) of domestic ruminants	Number (%) of positive samples	P value
Wards	Bolisa	30 (10.9)	6 (20.0)	0.592
	Chemchem	32 (11.7)	12 (37.5)	
	Kilimani	32 (11.7)	7 (21.9)	
	Kingale	45 (16.4)	7 (15.6)	
	Kolo	30 (10.9)	1 (3.3)	
	Kondoa Mjini	30 (10.9)	5 (16.7)	
	Serya	43 (15.7)	11 (25.6)	
	Suruke	32 (11.7)	3 (9.4)	
Type of domestic ruminants	Cattle	106 (38.7)	26 (24.5)	0.359
	Goat	137 (50)	20 (14.6)	
	Sheep	31 (11.3)	6 (19.4)	
Breed	Cross breed	11 (4.0)	1 (9.1)	0.394
	Local	263 (95.9)	51 (19.4)	
Age	Adult	263 (95.9)	48 (18.3)	0.134
	Young	11 (4.0)	4 (36.4)	
Sex	Female	188 (68.6)	38 (20.2)	0.442
	Male	86 (31.4)	14 (16.3)	
Grazing system	Extensive	236 (86.1)	48 (20.3)	0.152
	Semi-intensive	38 (13.9)	4 (10.5)	
Herd size	Small	222 (81.0)	40 (18.0)	0.323
	Medium	41 (14.9)	7 (17.1)	

Parameter	Category	No. (%) of domestic ruminants	Number (%) of positive samples	P value
History of abortion	Large	11 (4.0)	5 (45.5)	0.002*
	Yes	27 (9.9)	11(40.7)	
	No	247 (90.2)	41(16.6)	

* Statistically significant $P < 0.05$ at 95% confidence interval

3.6. Risk Factors for *Leptospira* Seroprevalence in Domestic Ruminants

A multivariate logistic regression was conducted to determine the effects of predetermined factors on the seroprevalence of *Leptospira* infection, with the results shown in Table

6. Domestic ruminants with a history of abortion were three times more likely to be infected with *Leptospira* (OR=2.7; 95%CI 1.1403 - 6.4293; $p = 0.024$). Likewise, the domestic ruminants kept in Kingale ward were six times more likely to be infected than those in Bolisa ward (OR=5.67, 95%CI 1.3021- 24.665; $p = 0.021$).

Table 6. Logistic regression analysis to assess predictors of *Leptospira* infection in Domestic ruminants.

Parameter	Category	OR	95% CI	P-Value
Ward	Chemchem/Bolisa	2.3796	0.56-10.14	0.241
	Kilimani/Bolisa	1.4969	0.32-7.03	0.6091
	Kingale/Bolisa	5.6671	1.3-24.67	0.0208
	Kolo/Bolisa	1.1505	0.22-5.92	0.8668
	Kondoa Mjini/Bolisa	1.26	0.22-7.37	0.7976
	Serya/Bolisa	3.4923	0.9-13.55	0.0707
	Suruke/Bolisa	1.2197	0.23-6.36	0.8137
Animal	Goat/Cattle	0.753	0.37-1.53	0.4326
	Sheep/Cattle	0.5461	0.19-1.59	0.2668
Breed	Local/Cross breed	2.1007	0.23-19.19	0.5108
Age	Young/Adult	1.9705	0.6-6.45	0.2622
Sex	Male/Female	0.9538	0.48-1.89	0.8923
History of abortion	Yes/No	2.7077	1.14-6.43	0.024
Grazing	Intensive/Extensive	1.1527	0.32-4.12	0.8268
Herd size	Medium/Large	0.723	0.18-2.85	0.6427
	Small/Large	1.3644	0.36-5.18	0.6479
	Constant	*	*	0.0002

4. Discussion

The purpose of this study was to determine the magnitude of *Leptospira* infection and identify potential risk factors in

domestic ruminants and rodents in Kondoa Town Council, Dodoma, Tanzania. *Leptospira* antibodies were detected in both animal groups, with four serovars identified in rodents and five in domestic ruminants. Co-infections were observed in rodents primarily involving *L. Pomona*, *L. Hebdomadis*, and *L. Lora*. *Avicantis* spp, was the most affected rodent

species, while domestic ruminants with a history of abortion and those raised in Kingale ward exhibited higher infection rates. These findings indicate that *Leptospira* is prevalent among domestic ruminants and rodents in Kondoa TC, posing a threat to livestock productivity, reproductive performance, and food safety. The frequent interaction between rodents and humans, combined with the consumption of food of animal origin represents significant public health concern. Therefore, coordinated measures, including routine surveillance, vaccination of livestock, and integrated rodent control, are recommended to reduce the burden of leptospirosis in Kondoa TC.

The study found a seroprevalence of *Leptospira* antibodies of 5.8% in rodents, with notable variation across species. Most of the detected *Leptospira* serovars were found in *Avicantis* spp, suggesting their significant role in local transmission dynamics. Rodents are recognized as primary reservoir hosts for various *Leptospira* serovars. They maintain and disseminate leptospires into the environment, facilitating transmission to humans and other animals through contact with contaminated soil, water, and food. Previous reports have documented *Leptospira*-related mortalities in dogs, particularly following rainy seasons, especially among those fed with raw, condemned meat such as pig and cattle kidneys [14]. Additionally, an outbreak in Kilwa District resulted in 20 confirmed human cases and three deaths, attributed to leptospirosis [10]. The findings of this study are consistent with those of [15] and [16] who reported *Leptospira* seroprevalence in rodents ranging from 5% to 10%. However, other studies have reported higher rates exceeding 10% [17-19]. Such variability in seroprevalence may be attributed to differences in sample size, rodent species composition, climatic conditions, laboratory diagnostic methods, and levels of environmental contamination with *Leptospira* [20, 21].

The seroprevalence of *Leptospira* antibody in domestic ruminants was 18.9% and most of the cases (24.5%) were detected in cattle. Detection of *Leptospira* in livestock is of significance since it localizes in the kidneys and reproductive tract, and may lead to mastitis, abortion, stillbirths, and reduced milk production. Infected animals shed the organisms mainly through urine and widely contaminate the environment and water bodies. Indeed, this study observed that livestock with a history of abortion were more likely to be *Leptospira* positive compared to others. Therefore, the repeated abortion reported in Kondoa TC sometimes may be caused by *Leptospira* infection. Other studies demonstrated the seroprevalence of *Leptospira* at various rates in domestic ruminants, suggestive of local exposure, since most of the livestock are extensively grazed where they interact with rodents, the major sources of infection [11, 22, 23].

Rodents reacted positively with four *Leptospira* serovars namely *L. Pomona*, *L. Sokoine*, *L. Hebdomadis* and *L. Lora*. Interestingly, co-infections were observed in rodents of *Avicantis* spp, between *L. Pomona*, *L. Lora* and *L. Hebdomadis*. Serovar *L. Lora* was most prevalent in this study; this obser-

vation is comparable to previous studies [11-13]. Other studies detected similar *Leptospira* serovars in rodents, while others reported different serovars depending on host-specificity, the common circulating serovars, sample size, climate, and laboratory methods [3, 17]. In domestic ruminants, five *Leptospira* serovars were detected, whereby *L. Pomona* was most prevalent but other serovars were: *L. Sokoine*, *L. Hebdomadis*, *L. Grippotyphosa* and *L. Canicola*. This is in line with other *Leptospira* studies in Tanzania and elsewhere [5, 11, 23-26]. Generally, studies report that there are more than 250 *Leptospira* serovars that circulate between animals, humans and the environment, which are all potentially pathogenic [27]. Therefore, detection of specific serovars in domestic or wild animals, especially rodents is of paramount importance as far as the control of the disease is concern [28].

Rodents were predominantly trapped in crop fields and human settlements, with *Avicantis* spp. and *Rattus rattus* being the most frequently encountered species. The high density of rodents in peri-urban and urban wards such as Kondoa Mjini and Chemchem suggests that densely populated areas, coupled with poor waste management and frequent environmental disturbances, create favourable conditions for rodent proliferation. These observations are consistent with previous studies, which have shown that human-altered environments support increased rodent populations and elevate the risk of *Leptospira* transmission [4, 11].

Overall, these findings emphasize ecological dynamics of leptospirosis transmission and the close link between human and animal health, particularly in resources constrained rural areas. The study reinforces the need for coordinated surveillance and intervention efforts grounded in One Health approach to effectively reduce the impact of disease burden in Tanzania and similar environments [29].

5. Conclusions and Recommendations

This study confirmed *Leptospira* infection in domestic ruminants and rodents in Kondoa TC, with prevalence rates of 18.9% and 5.8%, respectively. The presence of co-existing *Leptospira* serovars, particularly *L. Pomona*, *L. Lora*, and *L. Hebdomadis* indicates current transmission risks between rodents, livestock, and humans, highlighting the zoonotic nature of leptospirosis in the Kondoa TC. Geographic location and history of abortion were risk factors for leptospirosis. The present study therefore suggests the need of One Health approach for effective control of leptospirosis in Tanzania.

Study Limitations

The present study was comprehensive; however, some limitations must be acknowledged. Six common *Leptospira* serovars that are circulating in Tanzania were employed in this study nevertheless, rodents and domestic ruminants could be exposed to other serovars, as explained by [3].

Abbreviations

MAT	Microscopic Agglutination Test
TC	Town Council
SPP	Species
CBPP	Contagious Bovine Pleuropneumonia
EMJH	Ellinghausen and McCullough Medium Modified by Johnson and Harris
PBS	Phosphate Buffered Saline
TALIRI	Tanzania Livestock Research Institute
COSTECH	Commission for Science and Technology

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Author Contributions

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Ethical Consideration

The study was conducted in accordance with the ethical guidelines of Sokoine University of Agriculture. A research permit (No. SUA/ADM/R.1/8/1307) was issued by the Vice Chancellor of Sokoine University of Agriculture on behalf of the Tanzania Commission for Science and Technology (COSTECH). Additional permissions were granted by the Tanzania Livestock Research Institute (TALIRI) (Permit No. TLRI/CC.21/042) and Kondoa Town Council (Permit No. KTC/D.50/13/179). Consent was obtained from all respondents before actual data collection. All data collected from respondents were treated as confidential and accessed only by the research team.

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Data will be available upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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